Does Structural Economic Vulnerability Matter for Public Indebtedness in Developing Countries?

Sèna Kimm Gnangnon

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TÉL. 04 73 71 74 00
FAX 04 73 17 74 28
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The author

Kimm Gnangnon
PhD Student
Clermont University, University of Auvergne, CNRS, UMR 6587, CERDI, F-63009 Clermont Fd.
Email: kgnangnon@yahoo.fr

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Abstract

In this study, we examine the effect of structural economic vulnerability of developing countries on their public indebtedness. We perform our econometric analysis by relying on 96 developing countries over the period 1980-2008. The results suggest evidence of a "U-shaped" relationship between the structural vulnerability and the total public debt in developing countries. In Low-Income Countries (LICs), the build-up of the total public debt is particularly explained by structural vulnerability. Accordingly, international institutions should take into account such structural vulnerability when designing development policies, especially the ones related to debt sustainability in developing countries and particularly LICs.

Keywords: Structural Vulnerability; Public debt; Fixed Effects.
JEL Classification: E60; H63; O10.

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All errors are the responsibility of the author and the views expressed in this paper are solely those of the author.

1. Introduction

This paper strives to explore the impact of structural vulnerability on the total public debt, especially in developing countries. The latter, through their history have been prone to several types of shocks[1] such as shocks to international commodity prices, natural disasters, conflict related shocks, global financial market shocks, shocks to international interest or exchange rates, shortfalls in external aid flows, shocks of sudden human diseases (e.g. SARS) which can hit tourist revenues, changes in host country policies for migrant labour, which can cut remittances (see Matthew M. and Bargawi H., 2004).

According to the World Bank classification, the developing countries group – different from that of high income countries – is heterogeneous and include low income countries (LICs), lower-middle income countries (LMICs), and upper middle income Countries (UMICs), the two latter are referring to as middle income countries (MICs). While high income countries are highly exposed to market development as well as natural disaster shocks, we can distinguish two groups of developing countries in terms of vulnerability to shocks: those that have a limited access to private financing (especially the LICs and certain MICs) and those with a higher access to market-related financing. Many LICs and LMICs have in fact, benefited from the substantial debt cancellation under international schemes such as the heavily indebted poor countries (HIPCs) initiative and the multilateral debt relief initiative (MDRI). However, these initiatives provided by the Paris Club (and several other creditors) left the world developing countries at very different levels of indebtedness (UNDP, 2010). Indeed, on one side certain countries (for instance, many countries in the MICs group as well as many countries in small island developing state[2], SIDS) have not benefited from the multilateral debt relief initiatives and have managed only to reschedule bilateral credits owed to the Paris Club. As a result, these countries incur persistent and unresolved high public debt burden as measured by both stocks (solvency) and service (liquidity) indicators. On another side, many countries including in LICs, despite the debt cancellation schemes they have benefited, are engaging in rapid debt accumulation (sometimes from the domestic markets

[1] Shocks is best defined as an event which impacts on an economy and which is "exogenous" – beyond the control of the government to prevent – though, neither the unexpected nature nor the lack of government control are inevitable (see Matthew and Bargawi, 2004).

[2] The group of SIDS is a group of small open economies established by the United Nations in 2009. These countries have the particularity to be highly exposed and vulnerable to external shocks. Note that certain countries of this group belong either to the group of Low-Income Countries or to that of Middle Income Countries.

that are developed especially in sub-Saharan Africa, see Christensen, 2005; Rocher, 2007 and Cabrillac and Rocher, 2009) which give serious cause of concern.

Several studies (for e.g. Guillaumont, 2006 and UNDP, 2010) highlight that the greater vulnerability to high levels of public debt is owed to a range of structural weaknesses (that we will develop further). Many developing countries lack the required economic policies (that we will call later the "resilience") to deal adequately with such shocks and to avoid the subsequent debt accumulation. The latter associated with a high level of debt service has in turn, limited the governments' fiscal space and abilities to respond effectively to these shocks.

The rest of the paper is structured as follows. In the next section (section 2), we will briefly present the state of the literature related to the definition and measurement of the concept of "economic vulnerability" in developing countries. From that literature review, we will also derive our preferred measure of "structural vulnerability". The section 3 will be devoted to the model of public debt accumulation that will help us examine how the latter is related to the structural vulnerability of developing countries. In section 4, we present our model specification, the discussion on the expected sign of covariates and the econometric method. In the section 5, we will expose and discuss the empirical results. The section 6 concludes and discusses the policy implications of this study.

2. The concept of 'economic vulnerability': A literature review on the definition and measurements

2.1 A literature review on the definition of 'economic vulnerability'

The concept of 'vulnerability' refers to that of 'risk'. There are several definitions associated with the concept of 'risk' depending on the disciplines where it is studied. Generally, vulnerability can be seen as the risk that a 'system' undergoes from negative change due to a 'perturbation' (see e.g. Naudé et al., 2009).

In economics, vulnerability is either associated with poverty where the concern is the risk of households falling into or remaining in poverty, or natural hazards and macro-level shocks where the concern is how the hazards adversely affect a country or region's economy (see e.g. Naudé et al., 2009). Guillaumont (2009) highlights that the first type of vulnerability can be derived from the second one. Our paper focuses on the second kind of vulnerability: the 'economic or structural vulnerability'.

The concept of 'economic vulnerability' was defined for the first time in 1990 by the Maltese Ambassador his Excellence Mr. Alexander Borg Olivier who states that 'such an index is important because it reiterates that the per capita GDP [gross domestic product] of island developing countries is not itself an adequate measurement of the level of development of these countries as it does not reflect the structural and institutional weaknesses and the several handicaps facing island developing countries' (Maltese Government, 1990: 7). Since then many conceptual and empirical studies[3] have been conducted on the issue of economic vulnerability. More specifically, many studies of Briguglio (e.g. 2004), Briguglio and Galea (2003), Cordina, (2004a, b) and Briguglio et al., (2008) define economic vulnerability as 'a country's proneness to exogenous shocks lying outside their control or its proneness to increased susceptibility of such a country to the adverse effects of these shocks'.

In the same vein, several studies of Patrick Guillaumont (see e.g. Guillaumont, 2009; Guillaumont and Cariolle, 2011) have been devoted to the study of 'economic vulnerability' where he defines 'the economic or structural vulnerability of a country as the risk of a (poor) country seeing its development hampered by the natural and external shocks it faces'. Thus the author considers two main types of exogenous shocks (in other words, two main sources of vulnerability):

- the environmental or 'natural' shocks which encompass, for instance, natural disasters (earthquakes, volcanic eruptions) and the more frequent climatic shocks (typhoons, hurricanes, droughts, floods, etc);
- external (trade-and-exchange-related) shocks which comprise, for instance, slumps in external demand, world commodity price instability (and correlated instability of terms of trade), international fluctuations of interest rates, and so forth.

Other domestic shocks such as unforeseen political changes are thus excluded from being exogenous.

All these studies make a distinction between the concept of 'economic vulnerability' and that of 'economic resilience'. For example, according to Briguglio (2008), economic resilience refers to the policy-induced ability of an economy to recover from or adjust to the

[3] The conceptual and empirical viewpoints of economic vulnerability are well documented in the literature (see e.g. Briguglio 1995, 2003; Atkins et al., 2000). Cordiana and Farrugia (2005) also provide a summary on the measurement issue of the concept of 'economic vulnerability'.

negative impact of adverse exogenous shocks and to benefit from positive shocks. Thus defined, economic resilience may take the form of higher savings and investments which may occur in the wake of pronounced uncertainty and may enable small island states to achieve high levels of economic development (Cordina, 2004). Guillaumont (2009) considers economic resilience as the capacity of a country to react to shocks. He highlights that this resilience depends more on current policy, is more easily reversed, and is less structural but may also comprise a structural element[4].

Briguglio (2003) develops the concept of the 'Singapore Paradox', according to which many small island states, in spite of their economic vulnerability, manage to generate a relatively high GDP per capita when compared to other developing countries. To explain this phenomenon, Briguglio (2003, 2004) takes the case of Singapore which experiences high rates of economic growth and high GDP per capita despite its high exposure to external shocks. Thus the 'Singapore Paradox' stems from the juxtaposition of economic vulnerability and economic (nurtured) resilience, where economic vulnerability was confined to inherent features which are permanent or quasi-permanent, while economic resilience was associated with man-made measures which enable a country to withstand or bounce back from the negative effects of external shocks.

2.2 A literature review on the measurement of economic vulnerability

In line with the definitions of economic vulnerability provided above, we summarise here the different measures of that concept. The propositions of vulnerability indices have mainly focused on the quantification of the special features of the countries by relying on indicators such as economic openness, export concentration, dependence on imports of energy and peripherality. Other approaches attempt to measure vulnerability in terms of the phenomenon, namely the variability of output and similar indicators.

The first vulnerability index was proposed by Briguglio (1993) and is composed of three variables: the exposure to foreign economic conditions, insularity and remoteness, and proneness to natural disasters. This index has been the subject of several modifications in

[4] According to Guillaumont (2009) a distinction close to this three component is given in Rodrik (1999) who, in looking at the risk of social conflict in countries facing external shocks, considers the individual severity of the shocks, the depth of latent social conflict (likely to increase the impact of the shocks), and the quality of conflict management institutions.

1995, in 1997, and updated by Briguglio and Galea in 2003. Other authors such as Chander (1996) and Wells (1996) follow the methodology adopted by Briguglio (1995) and propose a vulnerability index. Wells (1997) revised its measure of vulnerability and uses a methodology that departs from the previous ones where he relies on the idea that 'vulnerability manifested in instability in economic growth'. He then uses regression analysis to build its index. Atkins et al. (1998) also adopt the econometric analysis and show evidence that export dependency ratio, merchandise export diversification and vulnerability to natural disasters are the main determinants of economic vulnerability (measured by output volatility). Crowards (2000) also contributes to the literature by suggesting an index of economic vulnerability for developing countries which is composed of more variables than in the previous studies. In line with Wells' (1997) study, the Committee for Development Policy (CDP)[5] of the United Nations (UN) developed a composite index in order to identify the causes of vulnerability of least developed countries (LDCs). By capturing vulnerability through economic growth instability, this index is a weighted average of five variables, namely the share of manufacturing and modern services in GDP, merchandise export concentration ratio, instability of agricultural production, instability of exports of goods and services and population size. The weights are obtained through an econometric analysis where the impact of each economic indicator quoted above on economic growth is examined. All these studies convey the same message according to which small states are inherently more vulnerable. However, Gonzales (2000) criticises these studies, arguing that they lead to considerable variations and contradictions due to the differences of the parameters and the methodologies employed by them.

Following the renewal growing concern over macroeconomic vulnerability of least developed countries and the demand of these countries to build an adequate vulnerability indicator which should be taken into account in the design of international development policies, the CDP has developed and progressively refined, after successive revisions (2003, 2006 and 2009) an economic vulnerability index which captures vulnerability caused by structural factors. The structural economic vulnerability employed in this study referred to the so-called 'retrospective Economic Vulnerability Index (EVI)' jointly calculated on an annual basis by the FERDI[6] (see Cariolle, 2011; Guillaumont and Cariolle, 2011) with the

[5] This committee was previously called Committee for Development Planning.

[6] FERDI is the 'Fondation pour les Etudes et Recherches sur le Développement International'. The method of retrospective EVI's calculation can be found in details in Cariolle (2011) and descriptive statistical analysis on the retrospective EVI can be found in Guillaumont (2011), and

UN/United Nations Department of Economic and Social Affairs (DESA). This indicator covers 128 developing countries over the period 1975–2008 (unbalanced panel data) and has the advantage of being simple, transparent and parsimonious. Moreover, several multilateral development banks are exploring whether to move from their traditional indicator to EVI for aid allocation (see Guillaumont, 2011, for more details).

The data available for our study (once we take into account all our variables – see below for the details on these variables) cover a panel of 96 developing countries over the period 1980–2008. This EVI is a result of three components: (i) the size and frequency of the exogenous shocks, either observed (ex post vulnerability) or anticipated (ex ante vulnerability); (ii) exposure to shocks; and (iii) the capacity to react to shocks, or resilience. Therefore, *structural vulnerability* (that is, the EVI), which results from factors that are independent of a country's current political will is different from the *vulnerability deriving from policy*, which results from recent policy choices. In other words, an index of structural economic vulnerability is related to structural factors—not policy factors—that are beyond the present control of the country and which also influence global vulnerability, mainly through resilience (Guillaumont, 2009). This structural vulnerability index is a composite index of 'shocks' and 'exposure to shocks'; both indicators are equally weighted[7]. We display below the structure of the (retrospective) EVI where the weights of indices are in brackets.

Structure of the EVI

- Exposure Index (50%)
  - -Smallness (50%)
  - -Location Index (Remoteness) (50%)
  - -Specialization Index (Merchandise Export concentration and share of agriculture, forestry and fisheries) (25%)
- Shock Index (50%)
  - -Natural Shock Index(Homelessness due to natural disasters; instability of agriculture production) (50%)
  - -Trade Shock Index (Instability of exports of goods and services) (50%)

Source: Guillaumont et al. (2011)

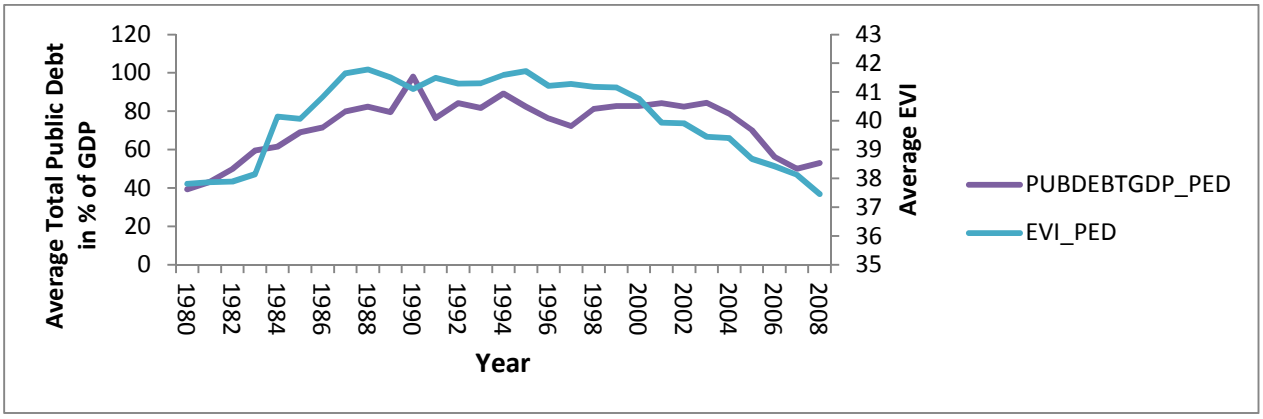
Guillaumont (2011) concludes with regard to each of these indicators that the LDCs appear, on average, to be more vulnerable than other developing countries and even more so when

Guillaumont and Cariolle (2011). This is why we do not find it useful to replicate this statistical analysis here and refer the readers to those articles.

[7] See for example Guillaumont and Cariolle (2011) for a discussion on the weight of indicators.

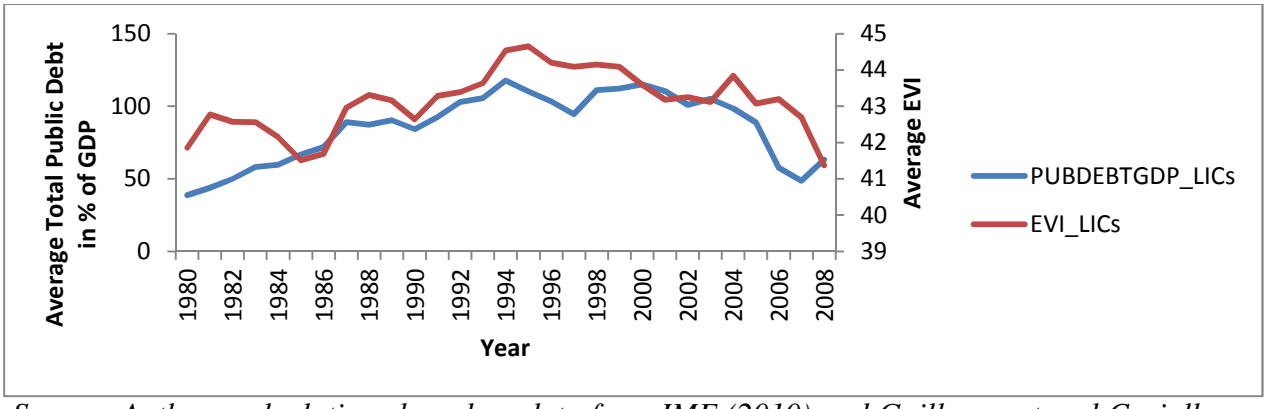
compared to other low-income countries. Figures 1–4 in the Appendix compare the evolution of the average total public debt with that of the average EVI for, respectively, the developing countries and the sub-samples of the low-income countries (LICs), lower middle income countries (LMICs) and the upper middle income countries (UMICs). Note that we do not include the group of small island developing states (SIDS) because of the insufficiency of data on certain explanatory variables (specifically the quality of governance). However, several countries belonging to this group also pertain to one of the three sub-groups of developing countries. All these graphs suggest a strong correlation between the average EVI and the average total public debt and a co-evolution of these two variables over time.

Figure 1: *Average Total Public debt and Average EVI of Developing Countries*



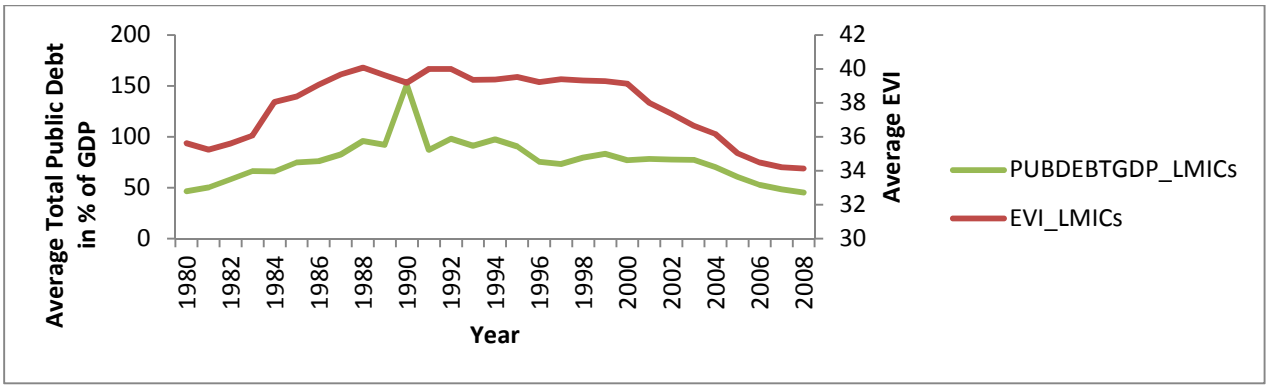
Source: Authors calculations based on data from IMF (2010) and Guillaumont and Cariolle (2011).

Figure 2: *Average Total Public debt and Average EVI of Low-Income Countries (LICs)*



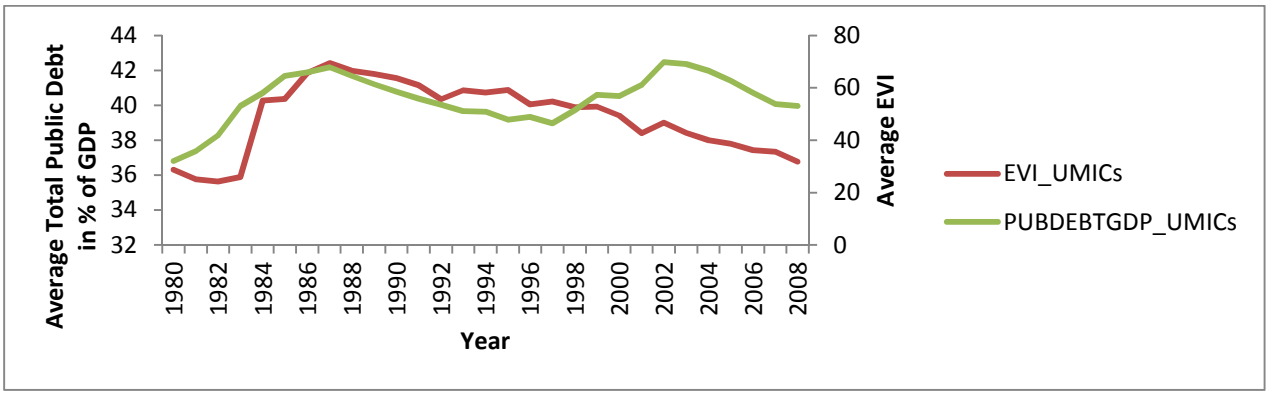
Source: Authors calculations based on data from IMF (2010) and Guillaumont and Cariolle (2011).

Figure 3: *Average Total Public debt and EVI of Lower Middle Income Countries (LMICs)*



Source: Authors calculations based on data from IMF (2010) and Guillaumont and Cariolle (2011).

Figure 4: *Average Total Public debt and EVI of Upper Middle Income Countries (UMICs)*



Source: Authors calculations based on data from IMF (2010) and Guillaumont and Cariolle (2011).

In the next section, we expose the simple mathematical model of the public finances sustainability usually described in the literature.

3. The presentation of the simple mathematical model of the public finances sustainability

Since the purpose of our study is to examine the effect of economic vulnerability on the total public debt, we start with a public finances sustainability model and then derive the appropriate model that will help us perform our regressions.

First of all, we find useful to mention that the concept of "debt sustainability" is improperly used in the discussions of international financial and fiscal policy issues in developing countries, whereas the relevant and the best known concept is that of fiscal sustainability, that is, the sustainability of public finances. The concept of fiscal sustainability refers to the fact that governments cannot maintain indefinitely the same set of policies (for e.g. expenditures and taxes policies) and remain simultaneously solvent. This means in other words that fiscal sustainability analysis is often not on defaulting itself – which governments try to avoid – but on the consequences of the policy changes needed to prevent defaulting (Vera, 2009).

Despite the old debate on that concept (it dated from more than a century now), there is no agreed definition on what constitutes a fiscal sustainable position. In fact, there are several methods proposed by the literature to assess the fiscal sustainability, depending on the time horizons (short, medium, or long term) and the variables considered.

In theory, the study of fiscal sustainability rests on the government's budget constraint which requires that current spending on goods and services plus the costs of servicing current debt equals current tax revenues plus the issuance of new debt. Thus, the debt financing from a long-term perspective is defined with respect to two main approaches (Cuddington, 1996):

- The first approach is the so-called "accounting" or Domar's approach. It is also named the borrower based approach and is defined on the basis of the static government's budget constraint. The latter is satisfied if the public sector is able to finance its current expenditures with its revenues and new borrowing, and meet or roll over its maturing liabilities; that is, if it is not liquidity-constrained.
- The second approach is the solvency criterion of government finances or the Present-Value Constraint (PVC) approach, also called the lender based approach. This approach relies on the intertemporal budget constraint which requires that the present discounted value of future primary budget balances should at least be equal to the outstanding stock of debt. Thus, the public sector cannot be a debtor and the private sector cannot be a creditor, in present value terms, any debt incurred should eventually be fully repayable. If there is debt at present, the primary balance should become positive at some date in the future in order for the present-value budget constraint to be respected.

Irrespective of the conceptual approach adopted, the fundamental block of the fiscal sustainability corresponds to a simplification of the government budget constraint (Vera, 2009). We rely in this paper on the mathematical model of fiscal sustainability underlying that fundamental block, to estimate the effect of structural economic vulnerability on public debt in developing countries.

We assume first that the government finances its deficit only by issuing debt. Hence, we exclude for the moment other financing items such as seigniorage revenue, privatization proceeds, and the sales of public assets.

Let us denote B_t the stock of the public debt at the end of the year t; i_t the nominal interest rate on total public debt; G_t and T_t be respectively the total tax revenue and the total government consumption (excluding interest payments on the total public debt).

The government budget constraint is given by:

Debt in period t = (Debt in period t-1) + (Primary Deficit +Interest Payments on public debt) or Debt in period t - (Debt in period t-1) = Primary Deficit +Interest Payments on public debt = Primary Deficit (in year t) + i_t *(Debt for period t-1).

This equation can be rewritten as: $(B_t - B_{t-1}) = (G_t - T_t + r_t B_{t-1})$ **(1)**

To analyze the evolution of the total public debt, we need to normalize the public debt by some measure of the country's ability to service and repay its debt: the most common choice is typically the nominal Gross Domestic Product, denoted Y_t. Thus, the evolution of the debt-to-GDP ratio could be obtained by analyzing derivative of $\frac{B_t}{Y_t}$: $\Delta(\frac{B_t}{Y_t}) = \frac{\Delta B_t}{Y_t} - \frac{B_t}{Y_t}\frac{\Delta Y_t}{Y_t}$ **(2)**

If we call $b_t = \frac{B_t}{Y_t} = \frac{B_t}{p_t y_t}$ and apply $\frac{\Delta Y_t}{Y_{t-1}} = g_t + \pi_t(1+g_t)$ and $\pi_t g_t \approx 0$, the expression (2) can be rewritten as $\Delta b_t = \frac{\Delta B_t}{Y_t} - b_t(\pi_t + g_t)$ **(3)**,

where π_t stands for the rate of inflation and g_t for real GDP growth. The substitution of (3) into (2) leads to: $\Delta b_t = \frac{G_t - T_t + rB_{t-1}}{Y_t} - b_t(\pi_t + g_t)$ **(4)**

By defining $\phi = \frac{G_t}{p_t y_t}$, and $\tau = \frac{T_t}{p_t y_t}$, then we obtain in terms of ratios to GDP:

$$\Delta b_t = (\phi - \tau) + \frac{rB_{t-1}}{p_t y_t} - b_t(\pi_t + g_t) \quad \textbf{(5)}$$

If we assume that the debt ratios are steady state and that the real rate of interest on debt is defined by $i = r - \pi$, the rearrangement of (5) leads to: $\Delta b_t = (i - g)b_{t-1} - (\tau - \phi)$ **(6)**

The equation (**6**) shows that if the primary surplus ratio is equal to zero, the debt-to-GDP ratio will grow or shrink at the rate $(i - g)$, within a framework where it is assumed that there is a level beyond which the debt-to GDP-ratio cannot or should not rise. Under this situation, the

public debt ratio increases when the real effective interest rate on government debt exceeds the growth rate of GDP (that is, when the growth-adjusted real effective rate is positive) unless there is a sufficient amount of primary budget surplus. In other terms, the Domar's condition for debt stability (and thus fiscal sustainability) can be held when the real GDP growth rate is higher than the real interest rate, even if the primary balance continues to be just zero.

4. The model specification, the discussion of the expected effects of covariates and the econometric technique

4.1 The model specification

When developing the previous model of fiscal sustainability, we assume that the budget deficit is financed only by debt creation. However, other financing items (such as those mentioned above) should be considered. For example, in developing countries, governments usually resort to the monetisation of deficit (the seigniorage); they can also use public investment to stimulate private investment or use it as a countercyclical tool and thus obtain revenues if the expected rate of return of the development projects related to public investment exceeds the cost of borrowing. In addition, the significant assets (buildings, mineral deposits and various forms of liquid reserves) held by governments in developing countries could provide them with substantial revenue, the latter being possibly used to alleviate the burden of public debt of these countries.

To take into account such items (at least partially) in the equation (6), we define the primary balance not as the difference between tax revenue and the government spending, but rather as the difference between the overall government revenue and excluding grants —with these revenue comprising several items, including other non-tax revenue— and non interest (primary) expenditure.

Overall, from the equation (6) and based on the discussion made above, the fiscal sustainability depends upon the following factors:

- the primary surplus; that is, the difference between the overall government revenue including seigniorage and other types of revenues and excluding grants, and the non-interest (primary) expenditure;
- the growth of real GDP;
- the real interest rate.

We take into account these elements and further augment the model with our variables of interest (the EVI or its components and/or as we will see later, their square values), as well as other control variables which are likely to influence both the variables of interest and the dependent variable (the overall public debt).

In fact, we follow a general approach that consists of estimating some version of the following equation: $D_{it} = \alpha X_{it} + \mu_i + \eta_t + \varepsilon_{it}$ (1) where i denotes the country index (i = 1,....., 96) and t denotes the year's index, t = 1980–2008. The dependent variable $D_{it} = (Debt / GDP)_{it}$ represents the total public debt as a percentage of GDP of the country i in year t.

The vector X_{it} represents the structural economic vulnerability variables (that is, the EVI or its components—and/or the square values of EVI or the squared values of its components). We also include in the model a set of other time-varying control variables which act as (economic) resilience-related variables. They include the fiscal balance (in percent of GDP), the GDP growth rate, the terms of trade, the real effective exchange rate, the grants (as a percentage of GDP), the inflation rate (captured here through the GDP deflator), and the quality of governance. The definition and the source of these variables are provided in Table 5 of the Appendix. Note that we present the model estimated with and without the institutional variable (quality of governance).

μ_i represents country fixed effects that are incorporated in the model and capture the heterogeneity among countries as well as the likely importance of unobservables correlated with the error term in determining the total public debt. The use of fixed effects μ_i in our regressions is dictated by two main reasons: first, since our sample is composed of heterogeneous countries, there are likely state-invariant and unmeasured factors (colonial histories, political and financial institutions and the degree of creditworthiness) correlated with the error term in determining the evolution of the public debt to GDP ratio. Second, our macro panel contains, in principle, most countries of interest (representing the whole population of developing countries, especially those that are structural vulnerable), and thus will not likely be a random sample from a much larger universe of countries where the use of random effects may be more suitable.

η_t are time-specific dummies that are included in all specifications to account for the general trends in the debt-to-GDP ratio, the swings in international economic policies and other common shocks to all countries, such as debt relief, that affect their public debt-to-GDP ratio over time.

The disturbance $\varepsilon_{i,t}$ is assumed to be i.i.d. (0, σ_ε^2)—that is, assumed not to be correlated with the explanatory variables of the model and the normality of which is not required (Baltagi, 2002).

In the next section we discuss the expected sign of the different regressors included in the model.

4.2 Discussion on the expected signs of the explanatory variables

Before proceeding to the discussion of the expected effects (signs) of our explanatory variables, we would like to mention that, in order to make our regressors predetermined with respect to the dependent variable (the total public debt), we take the precaution to use where it appears necessary the lagged values of the explanatory variables. This allows us to avoid simultaneous relationships between certain regressors and the dependent variable.
Now what about the expected effect of each explanatory variable?

The EVI's variable

In analysing the effect of economic vulnerability on economic growth, Cordina (2004a, b) shows that increased risk can adversely affect economic growth as the negative effects of downside shocks would be commensurately larger than those of positive shocks. Furthermore, he presents a conceptual application of the 'Singapore Paradox' approach and shows evidence that, in response to a situation of vulnerability, saving and capital formation in an economy can be important sources of resilience. Guillaumont (2009) discusses the effects of each component of the (retrospective) EVI on economic growth and poverty. He concludes that the EVI reduces economic growth and, through the latter, exerts deleterious effects on the pace of poverty reduction. These impacts occur through the channels of export earnings instability, the primary instabilities (especially through their effects on public finances or through the passed through price fluctuations to producers), political instability, the smallness of the country, the structure of the economy and the location of the country.

More recently, Ferrarini (2009) re-assessed the analysis underlying the New Debt Sustainability Framework (NDSF) endorsed by both the Bretton Woods Institutions (the IMF – International Monetary Fund - and the World Bank), which guides the borrowing decisions of low-income countries. This re-evaluation consists of testing the significance and the reliability of the World Bank's CPIA – Country Policy and Institutional Assessment - or the governance indicators as predictors of debt distress episodes across LICs. He obtains strong evidence that factors of illiquidity and structural vulnerability[8] are more suitable predictors of

[8] The EVI used is that of United Nations Department of Economic and Social Affairs—Division of Sustainable Development.

the occurrence of debt distress episodes across low-income countries (LICs). Thus by challenging the NDSF prospects, whose aim is to solve the long-standing debt crisis involving many of the LICs, the author concludes that 'the NSDF is bound to distort aid allocation away from the country-specific circumstances which truly matter for the achievement of debt sustainability.

Based on this short literature review related to the macroeconomic impact of EVI, we discuss its possible impact on public debt.

The structural vulnerability, by reducing tax revenue (unless the government increases taxes after an exogenous shock or when its exposures to shocks rises, though such measure is politically sensitive and difficult to implement) and increasing government spending is expected to increase the budget deficit. We hypothesise that, irrespective of its effect on the public finances (the budget deficit), the structural vulnerability of a country is expected to increase its public indebtedness. However, when a government experiences a structural vulnerability of its economy, instead of borrowing even at low cost to cope with the additional financial needs induced by such structural vulnerability, it can rely on non-costly financial means such as the privatisation proceeds, the seigniorage and the sale of its liquid assets. In such cases an obtained positive effect of EVI on the accumulation of public debt may cancel out the effect of the fiscal balance (the coefficient of the variable capturing the 'the fiscal balance' may not be statistically significant). We can also interpret the cases where in the regressions both the fiscal balance and the EVI appears to be statistically significant by the fact that countries facing structural vulnerability benefit from debt forgiveness from their creditors (the extra revenues are used to cope with the shocks).

Furthermore, we can conjecture the existence of a non-linear relationship between EVI and the overall public debt. The argument underlying this hypothesis is the following: even if as EVI rises, the government could draw on its previously quoted non-costly financial means to cope with the additional financial needs, for high levels of EVI, the government will have no choice but to have recourse to external and/or domestic borrowing. Therefore, if we introduce both the linear and the squares terms of EVI in the model, we expect a positive effect of the squared EVI's variable and a negative effect of the EVI's variable. In the meantime, the significance of the effects of these two variables (the EVI and its square) may cancel out the effects of the fiscal balance and an interpretation of the results could be that countries facing higher EVI benefit (temporary) from debt forgiveness from creditors. The same reasoning applies to the components of EVI that will include in the regressions in replacement of EVI itself.

One can also expect the accumulation public debt to rise in the first stages of EVI rises (if the countries choose to borrow internally or abroad to accommodate the EVI increases) and then to decline for higher EVI, because of the debt relief granted by creditors or the use of non-costly financial resources or also the adoption of fiscal adjustment measures. Hence, the sign of 'EVI' or its components will be positive and that of its square or its components' square will be negative.

The fiscal balance: as mentioned above, we expect an improvement in the fiscal balance to reduce the overall public debt. If the EVI (or its components) effect translates through the fiscal balance, the impact of the latter on public debt will be statistically nil. However, we acknowledge that a statistically nil effect of fiscal balance may not necessarily be due to the presence of the EVI or its components in the model, but may also be explained by the effect of other control variables of the model that influence the fiscal balance (e.g. economic growth; the terms of trade; the quality of governance).

The real GDP growth: we expect the indebtedness of a country to rise following losses in output; that is, lowering of real GDP growth (see also Barro, 1979). Accordingly, the real GDP growth is expected to be negatively related to the accumulation of public debt.

The real effective exchange rate

The real effective exchange rate (REER) indicates a country's competitiveness. In our case, a rise in the REER means an appreciation and a decline means depreciation. The effect of the real effective exchange rate on the overall public debt of a country depends on its effect on the domestic and external debt.

Regarding the domestic debt, on the supply side its issuance may be easier to countries when the currency is appreciating because the expected appreciation allows prudent policymakers to hide the implicit insurance premium embedded in domestic currency borrowing (Caballero and Cowan, 2006; Panizza et al., 2011). On the demand side, a real appreciated exchange rate is, at any given interest rate, likely to discourage the demand of domestic currency bonds as investors may foresee an ex-post appreciation of the foreign currency rate (a real depreciation of local currency; see also Panizza et al., 2011). Furthermore, in terms of valuation effects, a real effective exchange rate appreciation (depreciation) automatically induces a higher (lower) domestic indebtedness of the government.

With respect to the external public debt, the effect of REER changes on its build-up is also ambiguous. In fact, a real exchange rate depreciation will lead to a declining of the external debt stock if the induced rise in export earnings of this depreciation is sufficiently enough to service the external debt; otherwise, the depreciation of the REER will result in a rise of external indebtedness (Craigwell et al., 2010; see also Ng'eno, 2000).

Overall, we cannot conclude a priori about the effect of REER changes on the accumulation of the total public debt (domestic and external debt).

The terms of trade

An improvement in terms of trade (an increase in the relative price of exportables for a country) is likely to increase the export (foreign) revenues of the beneficiary country, reduce current expenditures and therefore improve the fiscal balance. Note that the reduction effect of public expenditures owe to the terms of trade improvement appears through a relative decline in the price of inputs (in the cases where imports represent an important share of expenditures - which is usually observed in many developing countries and a fortiori, in CFA Franc Zone countries). Furthermore, such improvement in terms of trade, by increasing the economic growth may also reduce the need for social assistance from government and in fine, add to the reduction of current expenditures. Thus, an improvement in terms of trade is expected to be positively related to lower external and /or domestic borrowing and by the same token, to a low probability of excessive debt.

Conversely, a decline in terms of trade, by lowering revenue, increasing (substantially) public spending and thus worsening the fiscal balance, will likely result in higher total public debt. As a result, the likelihood of excessive debt will rise. The positive effect of such terms of trade deterioration on public expenditures translated through for example, the rise of social assistance needs, and the high demand by public enterprises of support from the government because they cannot adjust their pricing policies to changes in export and import prices.

The grants

According to Cline (2003), since in low-income countries (LICs) the grants elements (foreign grants, which represent a substantial fraction of GDP) are available to pay some part (or all) of the interest due on debt, it is important to modify our previous debt sustainability condition by taking into account the amount of foreign grants as a fraction of GDP. This is why we include in our model specification the foreign grants as a percentage of GDP. We thus expect the grants to alleviate the burden of indebtedness of developing countries—that is, to exert a

negative effect on public debt. But we can also hypothesise that the higher the grants are for a developing country, the less it will be inclined to correctly manage its public finances to avoid unsustainable debt situations. In such instances, the grants will exert a positive effect on the total public debt.

The inflation rate

The impact of inflation on the public debt depends on how the latter is distributed among domestic and foreign creditors. In the case of developing countries where (usually) a substantial part of the public debt is denominated in foreign currency, the inflation impacts directly the domestic debt-to-GDP ratio and indirectly the ratio of external debt to GDP through the real effective exchange rate.

A rise in inflation erodes the real value of the domestic debt hold by creditors and the effective debt ratio, unless all domestic debt is indexed to prices or foreign currencies (though according to Panizza et al., 2011, in such cases inflation can debase indexed to prices if the government tinkers with the price index), a government can inflate away the domestic public debt by money creation, with the result of this inflating away of debt depending on the share of debt that is indexed to inflation. Panizza et al. (2011)[9] also point out the exceptional case where inflation can lead to a rise of public debt: in the case of a country facing a real appreciation (that is, where inflation outweighs the currency depreciation) and where a large share of domestic debt is indexed to inflation, the valuation effects will create a positive link between inflation and domestic currency debt.

The quality of governance

We expect the better quality institutions (especially fiscal ones) to be associated with a lower public debt. In addition, there is a need for developing countries (especially small countries and LDCs) that are structurally vulnerable to set up the adequate institutions that should promote competitiveness, build economic resilience and promote sustainable development (Farrugia, 2007). Thus the institutions in developing countries and particularly in small countries should be as strong as possible to reflect the governance aspects inside their economic environment. Therefore we include in our model the variable 'quality of governance' and expect it to be negatively associated with the build-up of public debt.

[9] These authors recognise, however, that such a situation is exceptional and argue it will likely be dominated by the case where inflation impacts negatively the domestic debt, in the absence of financial repression.

4.3 The econometric technique

As the time and cross-sectional dimensions of our panel data are important (T = 29 and N = 74), there will likely be serial correlation, heteroscedasticity and contemporaneous correlation in residuals of the model. Therefore we perform three statistics tests where the null hypotheses are respectively: the absence of autocorrelation test (Wooldridge AR[1] test); the homoscedasticity test and the absence of cross-sectional dependence[10] test (unfortunately, because of the unbalanced and short nature of our samples, we are not able to implement any of the available tests for cross-sectional dependence; Hoyos and Sarafides, 2006). The results that can be obtained upon request allow us to conclude for the presence of serial correlation and heteroscedasticity in the residuals. To address these concerns, we use the fixed effects technique with the Driscoll and Kraay's[11] (1998) standard errors. In fact, in addition to their heteroscedasticity consistence, Driscoll-Kraay's standard errors estimates are both robust to within- and between-group[12] dependence (robust to very general forms of spatial and temporal dependence in the residuals when the time dimension of the panel is large[13]). The spatial correlation may in practice result from unobserved common shocks to the total public debt that is not captured either by the time dummies or by the other determinants of the public debt.

Another econometric technique that could allow us to perform our regressions using fixed effects while dealing with serial correlation, heteroscedasticity and contemporaneous correlation in the residuals is the panel corrected standard errors (PCSEs) developed by Beck and Katz (1995). However, for the reason mentioned above (the unbalanced and shortness nature of our sample and sub-samples), we cannot use this technique. Finally, we rely solely on the fixed effects technique where standard errors are computed using the Driscoll-Kraay (1998) technique.

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[10] The erroneous ignorance of spatial correlation in panel data estimation severely biased the estimates.

[11] We perform our regressions using the stata's command 'xtscc' implemented by (Hoechle, 2007) to obtain Driscoll and Kraay's covariance matrix.

[12] The robustness of Driscoll-Kraay's standard errors are certainly based on asymptotic theory, but their values have been demonstrated in panels down to T = 5 (Hoechle, 2007).

[13] Driscoll and Kraay's robust standard errors underperform White's robust standard errors in the absence of between-group dependence while outperforming in its presence (Hoechle, 2007).

5. The empirical results

In this section, we discuss the results (Table 1 to Table 4) obtained from the estimations of the model by the use of the fixed effects where the standard errors are corrected with Driscoll-Kraay's (1998) technique. We consider the full sample of developing countries as well as the sub-samples of LICs, LMICs and upper middle income countries (UMICs) and report their results in all the four tables. In Table 1 we report the results related to the model with only EVI and the control variables; Table 2 contains the results with the EVI's components and the control variables; in Table 3, we display the results associated with the EVI, its square values as well as the control variables; and, finally, Table 4 reports the results of EVI's components, their squares and the results of the control variables. As we mentioned earlier, in all these tables we provide both the results with and without the variable capturing the governance quality, but we always interpret the results of the model with the 'quality of governance's' variable.

Consider first our full sample of developing countries. The results in Table 1 suggest that, irrespective of the control variables effects, including the quality of governance, EVI appears to increase significantly the build-up of total public debt. Note, however, that the variable 'fiscal balance' is not statistically significant when we control for the quality of institutions. These results are confirmed when we replace the EVI by its two main components: the higher the exposure of countries to shocks or the higher the shocks these countries face, the higher the total public debt they incur. However, the introduction of the square values of EVI in the model (see results in column [2] of Table 3) suggest, all other things being equal, evidence of a non-linear relationship (in the form of a U curve) between EVI and the total public debt: on average, as the EVI increases, the total public debt decreases but beyond the threshold value of EVI of approximately 37.5, an additional rise in EVI is associated with an accumulation of public debt. In the meantime, the effect of fiscal balance is statistically nil. As we have already discussed in section 4.2, this result can be explained by the fact that, until an average threshold of 37.5 for the EVI is reached, these countries use their non-costly financial means (either privatisation proceeds, or seigniorage, or the sale of public assets or public investments proceeds) to cope with such structural vulnerability. When being hit by external shocks and/or when their exposure to shocks rises, they may also benefit (temporarily) from debt forgiveness (relief) from the multilateral institutions or the bilateral creditors. However, beyond this threshold, countries do not have other options than borrowing either abroad (inducing an increase in external debt) or domestically (thus increasing the

domestic debt) which leads to a higher total public debt. Turning to column 2 of Table 4, we also observe a non-linear relationship (in the form of a 'U' curve) between the EVI's components and their square values, and the total public debt. Indeed, the higher the exposure (or the shocks), the lower the build-up of public debt—but beyond a threshold (approximately 33.4 for 'exposure' variable and 55.6 for 'shock' variable) public debt rises significantly with the increases in exposure to shocks or shocks. The explanation is the same as the one provided above. Note that the fiscal balance doesn't appear to be statistically significant here either.

Regarding the other control variables, we observe from Tables 1 to Table 4 that the variables 'economic growth, terms of trade, and quality of governance' exhibit the expected sign.

Consider now the three sub-samples. For LICs (column 4 of Table 1), neither the EVI nor the fiscal balance appears to explain the build-up of public debt. Among the control variables, the accumulation of public debt is rather explained by a decline in economic growth, a deterioration of the terms of trade or a depreciation of the real effective exchange rate. The EVI's impact of the lower middle income countries (LMICs) on their total public debt is statistically nil, whereas an improvement in the fiscal balance, an increase in economic growth or a lower inflation (though statistically significant at only 10% level) reduces their indebtedness. The build-up of public debt in UMICs doesn't appear to be affected by fiscal balance, but is rather driven by a low economic growth (though statistically significant at only the 10% level), a deterioration in terms of trade (though statistically significant at only the 10% level), an appreciation of the real effective exchange rate, lower inflation, a rise in grants and a low quality of governance. These results are roughly confirmed when we turn to Table 2 where the EVI is replaced by its components, but the significance level of certain coefficients differ from those observed in Table 1.

The results are more interesting when we introduce either both the EVI and its square values or its components and their square values in the model (see Tables 3 and 4). We find evidence of no non-linear relationship between EVI and the public debt for LICs, suggesting that the introduction of the square values of the EVI cancels out the effect of EVI. In addition, this squared EVI variable is not statistically significant. This may give rise to conclude (in reference to column [4] of Table 1) that, for LICs, EVI influences positively and significantly the build-up of public debt. However, the results in Table 4 suggest evidence that an increase

in shocks or in exposure[14] to shocks in these countries affects on average positively and permanently their accumulation of public debt over time. It is worth highlighting that, for the LICs, the same control variables are significant in all the tables.

Regarding LMICs and UMICs (columns 6 and 8 of Tables 3 and 4), the findings are different. Indeed, the results (Table 3) are suggestive of a non-linear relationship in the form of a 'U' curve between EVI, its squares and the total public debt, or the EVI's components, their squares values and the total public debt for both sub-samples of LICs and LMICs. The threshold calculated for LMICs is 39.25 while that of UMICs is 34.14. In addition, in contrast to previous results, fiscal balance is as expected, significantly and negatively associated with the indebtedness of LMICs and UMICs. This means that the non-linear effect of EVI on the rise in public debt does not translate neither through the public revenues and/or public expenditures of government nor through economic growth which is negatively associated with the total public debt in both LMICs and UMICs. For LMICs we can conclude that this effect translates through the non-statistically significant control variables that are the terms of trade, the real exchange rate and the grants (in percentage of GDP). As mentioned above, we can also interpret this observed effect of EVI that does not translate through the 'fiscal balance' by the fact that LMICs, when facing moderate structural shocks and exposure to shocks (characterised by an average EVI under 39.25), benefit from some debt relief which allows them to cope conveniently with the rise in their structural vulnerabilities. For UMICs, the economic interpretation of the 'U' shaped curve observed between EVI's variables and the total public debt is different. In fact, in addition to the significant effect obtained for the EVI and its squares values, the effect of all other control variables appears to be statistically significant: the decline in public indebtedness is explained in UMICs by a strong fiscal balance, a higher economic growth, an improvement in terms of trade, an appreciation in real effective exchange rate, a decline in grants and better quality of governance. This suggests that, for the UMICs, EVI variables impact on the total public debt (under the threshold value of 34.14), translated through other channels, may be the debt relief. In Table 4 where we replace EVI and its squares by EVI's components, we observe that, for LMICs, the 'U' shaped curve exists between the 'exposure' variable and the public debt but not between debt and the 'shock' variable where the latter is linearly associated with the dependent variable. Fiscal balance is here negatively and significantly associated with the public debt. Among the

[14] Note that the coefficient of this variable is statistically significant at the 10% level only).

other control variables, only the improvement in economic growth and a lower inflation explains the decline in the total public debt. Concerning the UMICs, the non-linear relationship between EVI and the public debt is dictated not by the square values of the variables 'exposure' and 'shock', but by the interaction between these two variables. This suggests that the effects of exposure to shocks in UMICs depend on the shocks these countries face, and vice-versa.

6. Conclusion and policy implications

In this study we explore how the structural vulnerability in developing countries influences their indebtedness. To do so, we use the (structural) economic vulnerability index (EVI) jointly computed by Guillaumont et al. (2011) and the UN-DESA and focus on a panel of 96 developing countries over the period 1980–2008. In addition to the full sample of the 96 developing countries, we also consider three sub-samples (according the World Bank's classification): low-income countries (LICs); lower middle income countries (LMICs) and upper middle income countries (UMICs). To perform our regression, we employ the fixed effects with Driscoll-Kraay's (1998) technique to correct standard errors for spatial and temporal dependence.

After controlling for several potential covariates, we obtain the following results regarding the EVI effects on total public debt:

- With regard to the full sample of developing countries, EVI affects positively the build-up of public debt, but this positive effect appears after a threshold of the EVI. In other words, we observe the existence of a non-linear relationship between the EVI and public indebtedness in developing countries. The same findings apply when we use EVI's components rather than EVI itself.
- When turning to the LMICs and the UMICs, we also obtain evidence of the existence of a 'U' shaped curve in the relationship between EVI and the public debt.
- In contrast to the LMICs and UMICs, we observe that, whereas EVI leads to the accumulation of public debt in LICs, a higher exposure to shocks or a higher shocks affects positively and permanently the public indebtedness of these countries.

These results suggest that, as for economic growth and other macroeconomic indicators, structural vulnerability also matters seriously for indebtedness in developing countries, particularly in LICs where the effect appears to be very strong. Accordingly, there is a need for the international community to take into account the structural vulnerability of developing

countries (especially LICs) in designing appropriate development policies, especially those related to debt sustainability.

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Appendix and Tables

***Table 1**: The effects of Structural Economic Vulnerability on Public Debt –Fixed Effects and Driscoll-Kraay Estimator (FE-DK)*

	Dependent Variable: Total Public Debt in percentage of GDP							
	Developing Countries		***LICs***		**LMICs**		**UMICs**	
Explanatory Variables								
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Evi	1.479***	0.787***	1.605***	0.519	1.027	1.223	0.624	1.018**
	(0.271)	(0.165)	(0.532)	(0.304)	(1.213)	(1.517)	(0.445)	(0.379)
$Fiscal\_balance_{t-1}$	-0.385**	-0.188	0.0306	0.314	-1.288***	-1.332***	0.182	0.485
	(0.184)	(0.250)	(0.365)	(0.469)	(0.323)	(0.322)	(0.341)	(0.336)
$Gdpgrowth_{t-1}$	-0.895***	-1.105***	-1.074***	-1.306***	-1.090**	-1.697***	-0.921**	-0.884*
	(0.154)	(0.165)	(0.208)	(0.243)	(0.396)	(0.522)	(0.353)	(0.475)
Termstrade	-0.138**	-0.168**	-0.0999***	-0.132**	-0.139	-0.136	-0.159**	-0.185*
	(0.0546)	(0.0607)	(0.0285)	(0.0508)	(0.157)	(0.195)	(0.0718)	(0.0945)
$REER_{t-1}$	-0.0213	-0.00330	-0.0460***	-0.0914***	0.0174	0.0209	0.0105	0.161**
	(0.0255)	(0.0373)	(0.0118)	(0.0277)	(0.0206)	(0.0206)	(0.0528)	(0.0653)
$Grantsgdp_{t-1}$	0.266	-0.0482	0.151	-0.226	0.502	1.022	1.215	5.290***
	(0.466)	(0.531)	(0.317)	(0.273)	(1.333)	(1.593)	(0.891)	(1.031)
$Inflation_{t-1}$	0.00264*	0.00204	0.000686	-4.21e-05	0.00776*	0.00622*	-0.00321*	-0.00362**
	(0.00132)	(0.00143)	(0.000704)	(0.000885)	(0.00379)	(0.00316)	(0.00169)	(0.00170)
Qog		-23.07**		-13.71		-32.05		-70.20**
		(8.677)		(19.67)		(36.58)		(25.73)
Constant	-	78.79***	1.920	-	61.70*	-	41.48	-
	-	(12.11)	(26.42)	-	(31.55)	-	(26.49)	-
Observations - Countries	1,809-96	1,375-74	688-33	471-24	624-34	509-28	497-29	395-22
Within R-squared	0.2234	0.2072	0.3908	0.3917	0.3050	0.3334	0.2076	0.2944
Significance of Country Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Significance of Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Standard Errors (corrected with Driscoll-Kraay technique) are in parenthesis. The sign "–" in the table means that the constant is omitted by the regression.

***Table 2**: The effects of Structural Economic Vulnerability on Public Debt –Fixed Effects and Driscoll-Kraay Estimator (FE-DK)*

	Dependent Variable: Total Public Debt in percentage of GDP							
	Developing Countries		***LICs***		**LMICs**		**UMICs**	
Explanatory Variables								
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Exposure	2.431***	1.570**	2.634***	2.091***	-0.335	-1.727	1.464*	1.459**
	(0.654)	(0.567)	(0.923)	(0.616)	(1.498)	(1.638)	(0.789)	(0.705)
Shock	0.646***	0.321***	0.680***	0.121	0.560	0.745	0.227	0.441**
	(0.123)	(0.0979)	(0.238)	(0.129)	(0.626)	(0.750)	(0.216)	(0.181)
$Fiscal\_balance_{t-1}$	-0.424**	-0.238	0.0200	0.273	-1.287***	-1.268***	0.121	0.446
	(0.180)	(0.241)	(0.395)	(0.488)	(0.331)	(0.329)	(0.351)	(0.332)
$Gdpgrowth_{t-1}$	-0.820***	-1.045***	-0.979***	-1.193***	-1.156**	-1.871***	-0.914**	-0.874*
	(0.160)	(0.168)	(0.187)	(0.238)	(0.433)	(0.560)	(0.339)	(0.466)
Termstrade	-0.144**	-0.180***	-0.106***	-0.161***	-0.130	-0.117	-0.150*	-0.181*
	(0.0536)	(0.0606)	(0.0244)	(0.0483)	(0.152)	(0.193)	(0.0759)	(0.0981)
$REER_{t-1}$	-0.0231	-0.00384	-0.0500***	-0.0931***	0.0164	0.0189	-0.00536	0.152**
	(0.0270)	(0.0382)	(0.0110)	(0.0276)	(0.0202)	(0.0205)	(0.0513)	(0.0626)
$Grantsgdp_{t-1}$	0.302	-0.00872	0.187	-0.172	0.519	1.084	0.599	4.581***
	(0.459)	(0.528)	(0.323)	(0.273)	(1.316)	(1.516)	(0.825)	(1.098)
$Inflation_{t-1}$	0.00239*	0.00188	0.000326	-0.000360	0.00785**	0.00649**	-0.00282	-0.00324*
	(0.00136)	(0.00145)	(0.000558)	(0.000825)	(0.00376)	(0.00304)	(0.00167)	(0.00163)
Qog		-22.17**		-11.99		-33.10		-71.34***
		(8.701)		(19.84)		(37.17)		(25.30)
Constant	-59.77*	49.40**	-	-	-	159.0**	-4.723	-
	(34.14)	(23.29)	-	-	-	(60.95)	(45.57)	-
Observations - Countries	1,809-96	1375-74	688-33	471-24	624-34	509-28	497-29	395-22
Within R-squared	0.2324	0.2114	0.4006	0.4031	0.3063	0.3418	0.2147	0.2988
Significance of Country Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Significance of Year Fixed Effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Standard Errors (corrected with Driscoll-Kraay technique) are in parenthesis. The sign "–" in the table means that the constant is omitted by the regression.

***Table 3**: The effects of Structural Economic Vulnerability on Public Debt –Fixed Effects and Driscoll-Kraay estimator (FE-DK)*

	Dependent Variable: Total Public Debt in percentage of GDP							
Explanatory Variables	***Developing Countries***		***LICs***		***LMICs***		***UMICs***	
	FE-DK	**FE-DK**	**FE-DK**	**FE-DK**	**FE-DK**	**FE-DK**	**FE-DK**	**FE-DK**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Evi	-4.370**	-5.988**	-4.728**	-1.922	-7.904*	-12.56***	-1.928***	-5.585***
	(1.800)	(2.148)	(2.196)	(1.606)	(4.110)	(4.236)	(0.577)	(1.330)
Evisq	0.0674***	0.0799***	0.0710**	0.0279	0.103**	0.160***	0.0311***	0.0818***
	(0.0215)	(0.0252)	(0.0299)	(0.0178)	(0.0445)	(0.0477)	(0.00597)	(0.0185)
$Fiscal\_balance_{t-1}$	-0.295*	-0.0486	0.0798	0.287	-1.173***	-0.946***	0.229	0.713*
	(0.161)	(0.203)	(0.348)	(0.438)	(0.360)	(0.324)	(0.349)	(0.350)
$Gdpgrowth_{t-1}$	-0.920***	-1.101***	-1.060***	-1.295***	-1.203***	-1.772***	-0.950**	-0.950**
	(0.139)	(0.161)	(0.197)	(0.234)	(0.397)	(0.500)	(0.346)	(0.459)
Termstrade	-0.141**	-0.172***	-0.106***	-0.137***	-0.112	-0.0805	-0.162**	-0.192**
	(0.0536)	(0.0530)	(0.0274)	(0.0488)	(0.142)	(0.167)	(0.0713)	(0.0820)
$REER_{t-1}$	-0.0250	-0.0118	-0.0464***	-0.0927***	0.00892	0.00806	0.00394	0.154**
	(0.0243)	(0.0374)	(0.0115)	(0.0271)	(0.0191)	(0.0192)	(0.0499)	(0.0617)
$Grantsgdp_{t-1}$	0.290	0.0469	0.220	-0.177	0.414	1.320	0.787	3.532***
	(0.436)	(0.480)	(0.317)	(0.265)	(1.211)	(1.209)	(0.849)	(1.236)
$Inflation_{t-1}$	0.00260**	0.00200	0.000811	1.11e-05	0.00658*	0.00400**	-0.00319*	-0.00384**
	(0.00122)	(0.00130)	(0.000790)	(0.000912)	(0.00325)	(0.00184)	(0.00170)	(0.00174)
Qog		-24.21**		-13.87		-39.60		-73.74**
		(9.050)		(19.80)		(31.18)		(28.57)
Constant	-	214.1***	128.6***	154.3***	237.4**	348.8***	91.91***	-
	-	(45.68)	(35.93)	(42.06)	(89.44)	(91.66)	(24.67)	-
Observations - Countries	1,809-96	1,375-74	688-33	471-24	624-34	509-28	497-29	395-22
R-squared	0.2430	0.2346	0.4084	0.3953	0.3406	0.4049	0.2162	0.3378
Significance of Country	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Significance of Year Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Standard Errors (corrected with Driscoll-Kraay technique) are in parenthesis. The sign "–" in the table means that the constant is omitted by the regression.

***Table 4**: The effects of Structural Economic Vulnerability's components on Public Debt – Fixed Effects and Driscoll-Kraay estimator (FE-DK)*

	Dependent Variable: Total Public Debt in percentage of GDP							
	Developing Countries		***LICs***		***LMICs***		***UMICs***	
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**	**(8)**
Explanatory Variables								
Exposure	0.873	-3.231*	-3.684	-5.651	-0.685	-9.643*	1.001	-2.219*
	(1.440)	(1.671)	(3.211)	(4.675)	(2.778)	(4.749)	(1.025)	(1.228)
Exposuresq	0.00563	0.0484**	0.0525	0.0912*	-0.00260	0.0784***	-0.00210	0.0187
	(0.0134)	(0.0187)	(0.0330)	(0.0525)	(0.0167)	(0.0270)	(0.0111)	(0.0155)
Shock	-2.961***	-2.834***	-2.348*	-0.432	-4.287**	-5.807**	-1.557**	-3.084***
	(0.917)	(0.989)	(1.369)	(0.821)	(1.953)	(2.108)	(0.615)	(1.020)
Shocksq	0.0243***	0.0255**	0.0155	0.0187***	0.0420**	0.0344	0.0106**	0.00347
	(0.00665)	(0.00918)	(0.0116)	(0.00460)	(0.0186)	(0.0242)	(0.00471)	(0.00642)
Exposureshock	0.0340*	0.0237	0.0375	-0.0196	0.0277	0.0801	0.0217**	0.0827***
	(0.0177)	(0.0156)	(0.0267)	(0.0145)	(0.0237)	(0.0492)	(0.00816)	(0.0245)
$Fiscal\_balance_{t-1}$	-0.339**	-0.107	0.0662	0.228	-1.280***	-0.749**	0.176	0.620*
	(0.151)	(0.215)	(0.362)	(0.414)	(0.302)	(0.341)	(0.367)	(0.319)
$Gdpgrowth_{t-1}$	-0.819***	-1.013***	-0.955***	-1.170***	-1.187***	-1.818***	-0.937***	-0.889**
	(0.139)	(0.149)	(0.187)	(0.247)	(0.376)	(0.499)	(0.335)	(0.419)
Termstrade	-0.150***	-0.184***	-0.110***	-0.180***	-0.106	-0.0718	-0.153*	-0.166*
	(0.0523)	(0.0503)	(0.0241)	(0.0488)	(0.121)	(0.155)	(0.0772)	(0.0935)
$REER_{t-1}$	-0.0278	-0.0131	-0.0509***	-0.0866***	0.00295	0.0116	-0.00996	0.169**
	(0.0255)	(0.0385)	(0.00981)	(0.0241)	(0.0165)	(0.0191)	(0.0533)	(0.0671)
$Grantsgdp_{t-1}$	0.342	0.105	0.277	-0.0896	0.522	1.435	0.379	3.773*
	(0.417)	(0.460)	(0.314)	(0.226)	(1.063)	(1.400)	(0.890)	(1.992)
$Inflation_{t-1}$	0.00228*	0.00182	0.000564	0.000152	0.00663**	0.00359*	-0.00268	-0.00270
	(0.00126)	(0.00125)	(0.000587)	(0.000774)	(0.00294)	(0.00185)	(0.00164)	(0.00173)
Qog		-26.03**		-8.165		-39.43		-64.69**
		(10.55)		(22.17)		(34.33)		(23.78)
Constant	36.15	183.8***	-	-	-	393.5***	36.54	147.8***
	(48.60)	(52.47)	-	-	-	(132.8)	(44.45)	(29.37)
Observations - Countries	1,809-96	1,375-74	688-33	471-24	624-34	509-28	497-29	395-22
Within R-squared	0.2576	0.2474	0.4235	0.4290	0.3519	0.4074	0.2261	0.3804
Significance of Country Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Significance of Year Fixed	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Note: *p-value<0.1; **p-value<0.05; ***p-value<0.01. Standard Errors (corrected with Driscoll-Kraay technique) are in parenthesis. The sign "–" in the table means that the constant is omitted by the regression.

Table 5: *Definition, Source of variables and Descriptive Statistics*

Variable and Definition	Source and Comments	Observations	Mean	Standard Deviation
Pubdebtgdp = Public Debt in % of GDP	IMF's database on Public Debt – The IMF's database weblink on Gross Public debt is: http://www.imf.org/external/ns/cs.aspx?id=262.	2502	73.911	69.6009
EVI = Economic Vulnerability Index	Guillaumont and Cariolle, J. (2011).	2689	40.21129	11.78031
Exposure = Exposure Index	Guillaumont and Cariolle, J. (2011).	2813	44.99438	16.25786
Shock = Shock Index	Guillaumont and Cariolle, J. (2011).	2689	35.85406	15.19042
Exposuresq	This is square values of the variable "Exposure". The data are computed by the Author based on data from Guillaumont and Cariolle, J. (2011).	3132	2361.679	1486.927
Shocksq	This is square values of the variable "Shock". The data are computed by the Author based on data from Guillaumont and Cariolle, J. (2011).	2982	1499.736	1271.295
Exposureshock	This variable is the interaction between the variables "Exposure" and "Shock". The data are computed by the Author based on data from Guillaumont and Cariolle, J. (2011).	2982	1653.404	954.9141
Fiscal balance = Fiscal Balance in percentage of GDP	Centre d'Etudes et de Recherches sur le Developpement International (CERDI)'s Public Finance Database. Fiscal balance is the overall revenue (tax and non-tax revenue), excluding grants minus government expenditures.	2238	5.995552	7.95282
Gdpgrowth = Real Gross Domestic Product (GDP) growth (annual %)	World Development Indicators (WDI) 2011	2685	3.716404	5.868998
Termstrade = Net barter terms of trade index (2000 = 100)	World Development Indicators (WDI) 2011	2317	110.7542	38.07181
REER = Real Effective Exchange Rate, Base 100 = 2000	CERDI's Database: This is the Real Effective Exchange Rate, base 2005 = 100 computed by CERDI: it is the ratio of prices in the country to	2602	183.4921	3023.179

	prices in the main import partners adjusted for variations in nominal effective exchange rate. An increase means an appreciation.			
Grantsgdp = Grants in percent of GDP.	Grants data are grants disbursements by all donors expressed in current millions of US Dollars. They are extracted from the OECD Statistical Database. The GDP used to calculate the ratio of Grants in percentage of GDP is extracted from the World Development Indicators (WDI) 2011.	2700	6.265069	9.459745
Inflation = Inflation, GDP deflator (annual %)	World Development Indicators (WDI) 2011	2684	61.08368	692.3285
Qog = Quality of Governance	The quality of governance is measured by subjective indices from the International Country Risk Guide (ICRG). The quality-of-governance index from ICRG used here is an 18-point scale, created by summing the following three six-point scales: corruption in government, bureaucratic quality, and the rule of law. See the ICRG for the criteria used in coding these measures. The rationale for corruption and bureaucratic quality is obvious. The rule-of-law definition indicates that this measure reflects the government's administrative capacity in enforcing the law, as well as the potential for rent-seeking associated with weak legal systems and insecure property rights. Source: International Country Risk Guide (ICRG) Data.	1821	0.4405577	0.1505406